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Americans Examine British Magnesium Foundries

Three American executives, Mr. H. W. Butterbaugh, Mr. T. W. Atkins and Mr. L. H. Davidson, have, after a visit to a large number of British magnesium foundries, published a summary of their findings in "Modern Metals." This is extremely interesting and similar reports from Britishers visiting other countries ought now to be available to the British technical Press. Amongst other things, the Americans report that the equipment used in sand foundries is similar in the two countries, and comment is made on the high proportion of girl labour used in this country. Our squeezer moulding equipment is stated to be different, as in many cases roll-over machines were used. Comment is made on the extensive use of loose pins on moulding boxes, particularly in mechanised units. "Contrary to expectation," they report, "the lack of registry between cope, cheek and drag is negligible. The U.S. foundrymen lay great stress on taking every care of the fixed pin flasks, yet our defective casting percentage due to poor registry appears to be much greater than that observed in the U.K."

Though wood is scarce, the report comments that metal patterns and coreboxes are not so extensively used as in the United States. The patterns, however, were deemed to be high grade, as they incorporated standardised runner and riser systems. Moreover, they were the subject of experiment for prototype castings until "consistently acceptable castings were made." This has allowed the maximum use of unskilled and semi-skilled labour with reduced variation in moulding. Few core-setting gauges were observed, but quite a few patterns appeared to be worn. Referring to sand practice, the report says that here the sands carry higher permeability and for small castings synthetic sands bonded with bentonite are used. For the larger ones, natural sands are favoured. High-permeability sands give increased soundness, but a somewhat rougher finish. Whilst most foundries used an oil sand for cores, one large concern used oil-free cores which were stated to be more friable. Whilst the tendency to shrinkage cracking was reduced, the use of these cores was thought to give less accuracy and rougher surfaces. After describing the normal system of coremaking used here, that is, bench work feeding a steel band conveyor and vertical continuous stoves, the report expressed some surprise at the use of stored cores without re-drying, especially in view of the humid nature of the British climate.

It is interesting to learn that, "generally speaking, more of an effort is made to design the pouring system so that standard temperatures can be used at which the metal will be poured, while in the U.S. it is quite often necessary to have greater variation of metal temperatures to fit mould conditions." Comment is made that we use the reverse feed extensively, having runners so designed to include numerous dirt traps. Only a few, however, use steel wool or perforated screens in the metal screen. "In no foundry," states the report, "did we observe welding for the repair of defective castings, and we were told that this method was not allowed." Up to now we thought the magnesium foundry industry was passing its examination with honours, yet the final phrase is: "Some consumers criticise the lack of accuracy maintained by sand foundries, and by way of comparison foundry practices in the U.S. apparently result in more accurate castings." Is it due to those worn patterns or the blackout?

We deem a report of this character most valuable. It is obviously honest and written by people well versed in their subject. It leaves the British foundryman with the comfortable feeling that he has made a good job of his war work and, given good conditions, he should be able to keep to the forefront amongst the world's technologists.

Contents

Americans Examine British Magnesium Foundries, 23.—Correspondence, 24.—American Foundrymen's Association, 24.—French Buying Commission for America, 24.—A Study of Moulding Methods for Sound Castings, 25.—Growth of the American Foundry Industry, 34.—Mould and Core Paints and Washes, and Parting Powders, 35.—Steel Castings by the Thermit Process, 36.—Personal, 38.—Steel Pipes for Iraq, 38.—News in Brief, 40.—Belgian Steel Industry, 40.— British Metal Corporation, 40.—New Companies, 42.—New Trade Marks, 42.—Wills, 42.—New Patents, 42.—Tin Undercoats on Painted Steel, 42.—Raw Material Markets, 44.—New Catalogues, 44.

CORRESPONDENCE

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

"CONSISTENCY AND THE CUPOLA"

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Having just read the Paper "Consistency and the Cupola" by Mr. C. A. Payne with great interest, I feel an urge to give the following details of my experience with this type of furnace.

On page 111, Mr. Payne names flexibility as one of the leading characteristics of the cupola. I can supply a good example of that. In Norrahammars Bruk the plant consisted of a mechanised foundry using about 5 tons of cast iron per hour all day and the old foundry pouring during the afternoon about the same quantity per hour. The problem of supplying iron for these two foundries from the same cupola was solved in the following manner:—The cupola was blown during the forenoon with reduced blast and easily produced the required 5 tons per hour of hot and clean iron. Half an hour before lunchtime an extra charge of coke was given to lift the bed, and at 1 o'clock the melting was continued with the full blast of a Jaeger blower. Until the pouring was finished at about 5 o'clock, 10 tons per hour of equally hot and clean iron was delivered from the spout of the cupola.

As to the individuality of cupolas I may mention that although the two cupolas were as exactly alike as man could make them, they nevertheless showed a considerable difference in, for example, the disposition to hanging. In the malleable foundry of the same firm the two cupolas, both equally alike in design and maintenance, always showed a characteristic difference in the loss of silicon and manganese.

The shaft of the cupola is, according to the Paper, said to be best when it is straight. That may be correct, if you have got the charging floor sufficiently high above the spout. But, when it is not—and that has been the case both in Norrahammar and here at Scania-Vabis, where I am now foundry manager—one cannot very well raise it without incurring considerable costs. In order to get sufficient material preheated in the shaft the only remedy is then to widen it above the melting zone. That is exactly what I have just done to my cupola. The immediate result was an iron 30-40 deg. C. hotter than previously and no cold runs during the week. Maybe in the future I shall be able to cut the coke ratio, or rather augment the iron rate, but at present I am enjoying the sight of an exceedingly hot iron at the spout.

Yours, etc.,

JÖRGEN DRACHMANN,
Foundry Manager, AB Scania-Vabis.

Södertälje, Sweden.

August 28, 1945.

P.S.—When does "Marksman" regain the necessary space for his highly enjoyable "Random Shots," which I have missed sorely in recent years?

AMERICAN FOUNDRYMEN'S ASSOCIATION

PLANS FOR 1946 INTERNATIONAL CONGRESS

The American Foundrymen's Association have announced plans to stage their 50th Anniversary Foundry Congress and Foundry Show in the Cleveland Auditorium, Cleveland, next May. Coupled with announcement of the 1946 event is the intention to stage the meeting as an International Foundry Congress, with attendance from foundrymen of Great Britain, France, Belgium, Russia, Mexico, South America, South Africa, Australia, China, and other countries. If held, this will be the third International Foundry Congress to which the American Foundrymen's Association have played host—the first being held in Detroit in 1926, the second in Philadelphia in 1934. The international aspects of the 1942 convention in Cleveland were cancelled due to war conditions. Interest in attending an International Foundry Congress in the United States has already been expressed by British and French foundry associations, the latter having been revived since the end of the European war in June.

The sudden complete cessation of war, it is felt, has made the problems of reconversion immediate and pressing almost overnight. A 1946 International Congress is expected to make available to the entire foundry industry, the most basic of all industries, many outstanding and hitherto secret developments which have played a tremendous part in helping to win the war, and will prove equally vital in the development of peacetime commodities. Manufacturers of equipment and supplies will be invited to display their products at this national meeting so as to assist castings producers in their reconversion problems and service to post-war industry.

FRENCH BUYING COMMISSION FOR AMERICA

Mr. J. M. Lainé, the honorary secretary of the Association Technique de Fonderie and head of the French foundry research organisation, has recently been in London, where he was breaking his journey on the way to America. He expects to be in the United States for several months, as he is commissioned to buy extremely large quantities of plant for the modernisation of the French foundry industry. Later in the year he will be joined by Mr. Jean Montupet.

Mr. Lainé was proud to report that, with but few exceptions, the French foundry industry had refused to work for the Germans. He himself had a narrow escape from arrest by the Gestapo. The timely firing of a revolver by an assistant provided the necessary few seconds. He confirmed that it is now the law of the land in France to add 1 per cent. to all manufacturers' invoices for research funds. He further reported that an official commission of French foundry owners is to visit the United Kingdom in the near future.

A STUDY OF MOULDING METHODS FOR SOUND CASTINGS*

American Foundrymen's Association Exchange Paper

By FREDERICK G. SEFING†

Introduction

A long accepted definition of engineering is "The art of organising and directing men and of controlling the forces and materials of nature for the benefit of the human race." During wartime the last phrase of this definition is distorted to read "for the *destruction* of the human race." Indeed, engineering is accused of just this by Major-General J. F. C. Fuller, C.B., C.B.E., D.S.O., British Army, retired, when he said:

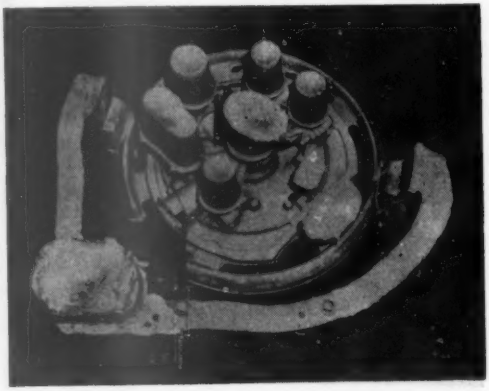


FIG. 1.—MOTOR HOUSING, MAGNESIUM CASTING. TOP VIEW.

Excessive venting by the use of open sand and vent risers is necessary for light metals. Note perforated steel sheet under pouring basin and slotted sprues set at an angle to prevent agitation.

"For more than a century science has been devoted to war and the potentials of war, for to-day every peace factory is a potential war factory."‡

He believes, however, that engineering can maintain a *Pax Scientia*, for he says further: "Since half the world has already been devastated by science working as a soldier, let us hope . . . instead of sitting on the patient's head and waving a truncheon, the (peace) conference will call in science as the physician to become the peacemaker." It is hoped that these international exchange Papers may contribute toward peaceful, scientific relationships between nations and peoples by fostering a cordial exchange of ideas.

This Paper has to do with that part of the definition of engineering given above which deals with "forces and materials of nature." It is to be hoped that they may soon be directed exclusively for the benefit, and not the destruction, of the human race.

The future of any foundry, indeed of the foundry

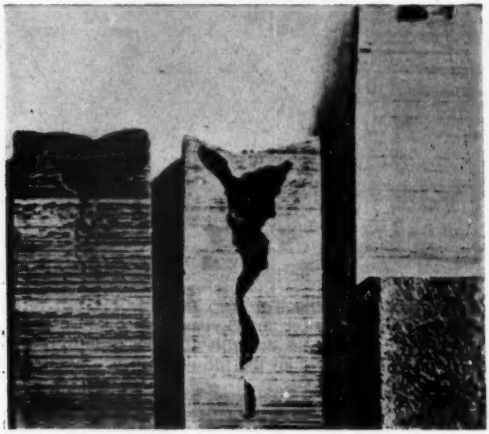


FIG. 2.—SOUND STEEL INGOT.
Production follows principle of controlled directional solidification. Right ingot was kept molten at top with "hot top."

industry, hinges largely on its ability to produce sound castings regularly. Freedom from casting defects is really as important to the user as the particular composition of metal desired. Indeed, sound castings not only satisfy the customer, but they also ensure profit for the foundry and assure repeat business. Satisfactory castings are dependable in service, cost the least to machine and to fabricate into machines, and, therefore, can command the highest prices for the foundry.

To produce sound castings, therefore, the greatest attention should be given to the moulding details. It is economical and shrewd business to spend time and money to study those moulding methods which make good castings. The factors involved in moulding satisfactory castings are the same for all metals. It is

* Paper read at the 42nd annual conference of the Institute of British Foundrymen, London, June 15 and 16, 1945.

† International Nickel Company, New York City.

‡ "Cure for War—A Scientific Surgeon," appearing in "Newsweek," March 5, 1945.

Moulding Methods for Sound Castings

proposed to show how simple these factors are and how easily and sensibly they can be applied.

I. Clean Metal and Gate Design

Clean metal poured into the mould cavity is of first importance. To this end the use of skim gates, slag traps, swirl gates, etc., is effective. In low melting point metals, such as aluminium, the use of coarse steel wool or a perforated steel sheet as a skimmer over the sprue is effective. In aluminium and magnesium pouring, agitation causes the trapping of some

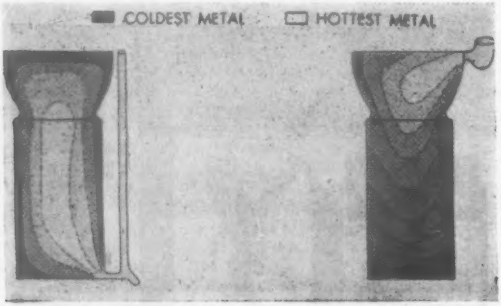
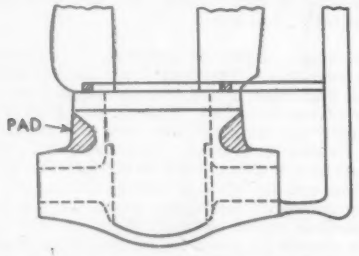


FIG. 3.—EFFECT OF TOP AND BOTTOM GATING ON TEMPERATURE DIFFERENTIAL.
Position of ingate controls the position of the cold and hot metal in the mould cavity.

of the surface scum. This is prevented by using slotted sprues (see Fig. 1). The thin deep slots and the angle of the pouring gates permit the metal to enter the mould with minimum agitation.

The cross-section of gates should be rectangular rather than square or round where they are attached to the casting, except when they are part of the feeding system. The rectangular rather thin gate section promotes more rapid freezing, therefore, produces soundness at the gate. The total area of the gates should be sufficient to have the maximum pouring speed without washing the sand. Filling the mould with adequately hot metal, which also means rapid pouring, promotes soundness by giving time for removal of slag and gas inclusions.



PADDING FOR CONTROLLED DIRECTIONAL SOLIDIFICATION

FIG. 4.—USE OF PAD TO PROVIDE PROGRESSIVE FREEZING FROM THE THIN TO THE HEAVIEST SECTION.

II. Position of Gates and Feeders

Controlled progressive solidification is not peculiar to steelfoundry practice alone, where Briggs, Gezelius and others did the early work, but it is applicable wherever molten metal is freezing. The earliest application of this principle was in making sound steel ingots. By comparing the ingots of Fig. 2, it is seen how sound ingots have been controlled in the steelworks by the use of "hot tops" to provide molten metal for feeding.

The principle involved in controlled progressive solidification is based upon the fact that the coldest metal

FIG. 5.—DESTROYER THROTTLE VALVE STEEL CASTING APPROACHING THE ULTIMATE IN POOR DESIGN.
Note the many light and heavy sections and the accompanying defects.

and the thinnest sections freeze first and the direction of freezing shall move, without interruption, toward the heaviest sections and/or the hottest metal in the mould. There should be no intermediate light sections or cold metal in a casting which would freeze early and interrupt progressive feeding. The accompanying Figs. 3-12 show how this principle is used to secure sound castings.

III. Effective Feeder Design

Helping risers or heads to feed castings involves several simple details. Proper feeder design and hot metal in the feeder are really applications of the principle of controlled progressive solidification. In no circumstances should rod feeding or pumping ever be permitted. More castings are lost by rod feeding than are ever saved.

(1) The design should be such that the feeder is

heavier than the section to be fed to be sure that the feeder and its connection will freeze after the casting. Feeders should have 50 per cent. greater cross-section or, simply, the thickness of the feeder should be 50 per cent. greater than the thickness of casting to be fed. Round feeders are more efficient than square cross-sections, because of less area to dissipate heat. Feeders attached to the side, particularly in grey iron, promote greater soundness than top feeders.

(2) The metal in the feeding head must be at least as hot or hotter than the metal in the castings (see Figs. 4, 7, 8*b*, 9 and 10). To have feeders contain the hottest metal in the mould, the metal should be poured by gating through the feeder. When this cannot be done, hot topping the feeder with an auxiliary ladle of metal will accomplish the same purpose.

(3) *Atmospheric Pressure Feeding.*—Feeders should be kept open to allow the atmospheric pressure to assist gravity in pushing the metal into the casting (see Fig. 16). This is accomplished by covering feeders with insulating compounds to prevent a skin of metal freezing over the top and thus permit the atmosphere to push the liquid metal down the feeder. Blind feeders and shrink bobs are of questionable value unless kept open to the atmosphere with rod cores which should extend from the sand of the mould through to the centre of the blind feeder. This device was patented by John Williams* in 1940 and is illustrated in Fig. 11. The success of the Williams feeder depends upon freezing a skin of metal around the casting, which puts it under a vacuum. The atmospheric air pressure in the feeder permeating through the rod core readily pushes the metal into the casting under vacuum. Because of the varying pressure tightness of thin skins of different metals just below the freezing temperature, the Williams feeder provides varying degrees of effectiveness. For example, grey iron is more permeable when hot than steel; therefore, the vacuum created in grey-iron castings is less than in steel and the effectiveness of the Williams feeder is decreased.

FIG. 6 (*a*).—UNSOUND BRONZE CASTINGS WITH RISERS.

Note the bosses are placed opposite the gates. Porosity occurred at the base of hub.

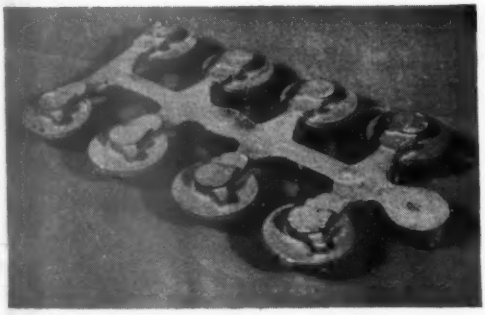


FIG. 6 (*b*).—SAME CASTINGS AS FIG. 6 (*a*), GATED PROPERLY.

Note that the castings were turned so as to gate through the heavy boss, eliminating the need of risers, with excellent results. The photograph shows the castings upside down with the sprue at the right cut off.

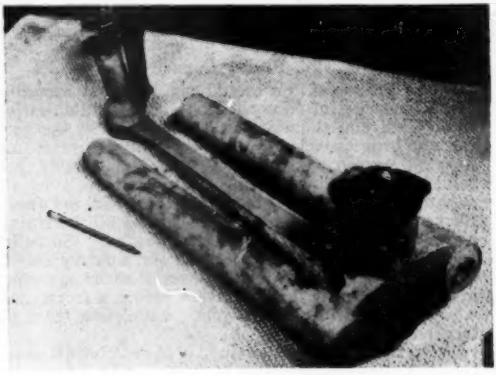


FIG. 7.—BRONZE CASTING GATED THROUGH THE FEEDER.

The coldest metal is at end farthest from feeder. Freezing progresses to the hottest metal at the freezer end. The long runner was used to accommodate the flask equipment. Tilting the mould 10 to 15 deg. is recommended.

* U.S. Patent No. 2,205,327.

Moulding Methods for Sound Castings

(4) Feeders should be high enough to afford plenty of hydrostatic pressure (see Figs. 12, 13 and 14). High feeders provide greater hydrostatic pressure in the mould, which assists in securing soundness by pushing gas, slag, etc., up through the liquid metal and out of the casting. This same liquid pressure of the molten metal seems to assist in feeding the casting. Sufficient liquid pressure should prevail to be greater than the gas pressure developed at the metal-mould interface.

IV. Feeder Capacity

When the metal in a mould cavity freezes according to the principle of controlled progressive solidification, the coldest and thinnest metal farthest from the gates freezes progressively toward the hottest metal and heaviest section. This means that the freezing portion of the casting is being fed progressively by the slightly hotter metal ahead. The metal in the feeder then must supply the metal necessary to fill the shrinkage requirements of the entire casting. So often foundrymen use feeders adequate for a heavy section of the casting, disregarding the overall shrinkage which may draw from the heavy section before it freezes and which must also be fed by metal withdrawn from the feeders.

With a great deal of coring, or with "hard" cores, the expansion of cores, and to some extent the moulds, will compensate for some of the shrinkage tendencies, and, indeed, in some cases may extrude liquid metal through the risers or feeders.

From data in the A.F.A. Cast Metals Handbook on volume changes of irons and steels, the theoretical feeder capacities for ferrous metals have been calculated, and are given in Table I. From the estimated weight of the casting, and employing the above feeder design features, the total weight or volume of the feeders can be calculated. The actual size of the feeder, adjusted for the expansion of cores, etc., will often be smaller than the theoretical size of feeder from Table I.

V. Feeder Connections

Feeder connections to the casting should have a reduced cross-section and be as short as possible. Fig. 16 shows a thin wall of core sand between the feeder, or riser, and casting, which sand becomes incandescent and which permits the feeder connection to remain fluid. This plate core may vary from ¼ in. to 1½ in., depending on section thicknesses. This method of feeder, or riser, attachment promotes greater soundness under the feeder and permits of easy removal. Generally, a sledge-hammer blow will remove the riser or feeder head, since the connection is essentially a deep notch. Fig. 15 illustrates an extreme example of a knock-off feeder. Feeder connection dimensions of one-third to one-half of the casting section dimensions have been found satisfactory by the Author. For example, a 1½-in. to 2-in. dia. connection is the maximum that need be used for a 6-in. thick head to feed a 4-in. section.

In Fig. 16, the relationship of feeders to the casting dimensions are given. Note that the side feeder extends below the connection by the same dimension as the feeder thickness. The purpose of depth of side

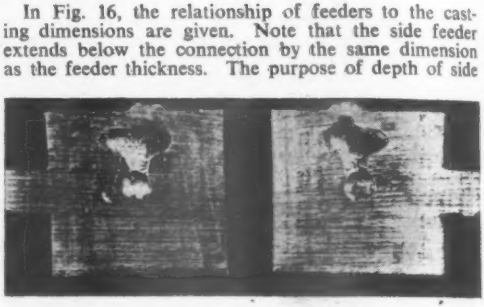
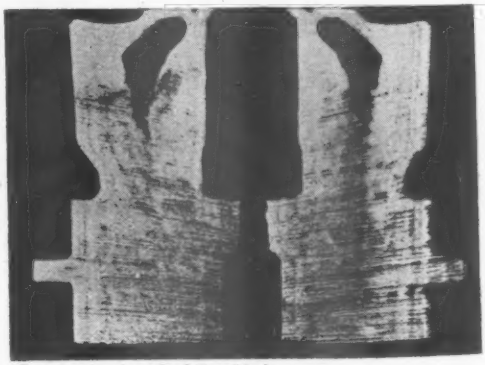


FIG. 8 (*a*).—STEEL CASTING SECTION, SHOWING SHRINKAGE CAVITY.

feeders below the connection is to have adequate volume of metal to prevent freezing in front of the feeder connections. Of course, the height of the feeder must be enough to prevent its shrinkage from extending below the feeder connection.

VI. Chills

Chills or denseners are used where feeders cannot be conveniently placed or to control the freezing rate (see Fig. 17). Their purpose is to do the same job as feeders by freezing the metal about as rapidly as it is poured and, therefore, heads for feeding are unnecessary. Indeed, when chills are used, great care must be exercised that feeders are so placed they are not close to chills and do not counteract the chill effect. Chills do cause the shrinks to "move somewhere else," *unless they are placed with due regard to controlled progressive solidification.*



(Courtesy American Steel Foundries.)

FIG. 8 (*b*).—SAME CASTING AS FIG. 8 (*a*) WITH FEEDER.

There are certain points regarding chills that must be kept in mind:—

(A) Chills must be clean. Slightly oxidised or rusty chills cause blows to develop in the casting next to the chill. *Before each use*, therefore, they should be sand-blasted and preferably wiped with waste dampened with kerosene to prevent slight rusting in the mould.

(B) They must not burn into the casting. Pouring over a chill or excessive agitation of the metal against the chill tends to cause burning in. The aim should be to have the mould poured before the chills have had time to warm up. Chills are protected from burning in by using chill coatings. The Author has found the following to be effective, although other refractory chill coatings are available.

(1) Silica flour mixed with linseed oil to a thin paint consistency. This requires heating to dry the surface; (2) one part of Cleveland core wash for steel and one part of McCormick Vulcan blacking; (3) Shaava mould and core wash (Mullite Refractories Company, Sheldon, Conn.); and (4) *Red Oxide Chiller Dressing*: 9¼ lbs. red oxide from Muirkirk, Md. Mineral Pigments Corporation; 1 gall. No. 983 chiller oil by Sun Oil Company. Mix thoroughly. This dressing does not require heat for drying.

(C) Chills must be large enough to penetrate their densifying effect across the section to be chilled, but not so large and sprawling that they prematurely freeze the metal in the lighter or adjacent sections. Precautions must be taken to prevent chilling the metal beyond the section to be densened or else the metal cannot feed into the portion of the casting to be densened.

(D) Chills are most effective when the metal moves up to them and is not agitated further. Where possible, they should be furthest removed from the gates so that when the metal pours against the chill, freezing commences.

(E) Rapid pouring permits the chill to do its most effective work, because the mould is filled with minimum warming up of the chill. The effectiveness of the chill is reduced if it has had time to warm up considerably before pouring is complete or before the metal in contact with the chill is quiet.

(F) Chills should be on the side or bottom of the mould cavity for most effective chilling.

TABLE I.—THEORETICAL FEEDER CAPACITY[1]

	Soft Grey Iron, 3.50-4.00 per cent. TC	Medium Carbon Grey Iron, 3.00-3.25 per cent. TC	High Test Grey Iron, 2.50-2.75 per cent. TC	Ni-Resist.	White Iron Chill Cast.	White Iron (Malleable).	Steel.
Pouring temperature, deg. C.	1,350	1,450	1,450	1,450	1,370	1,510	1,620
Weight of feeder (per 100 lbs. of casting) (lbs.)—							
Round[2]	1.75	11.0	13.0	15.0	15.2	19.75	19.75
Square[3]	2.80	17.6	20.8	24.0	24.4	31.60	31.60
Volume of feeder (per 100 lbs. of casting) (cub. in.)[4]—							
Round[2]	7.00	44.0	52.0	60.0	60.8	79.00	79.00
Square[3]	11.20	70.4	83.0	92.0	96.7	126.50	126.50
Liquid contraction[5] down to freezing temperature (per cent.)	2.2	2.4	2.2	2.1	0.25	1.75	2.72
deg. C.	1,150	1,230	1,250	1,260	1,350	1,350	1,450
Shrinkage during freezing (per cent.)	−1.6 (expansion)	1.8	2.8	3.5	5.50	5.50	4.50 (ave.)
Total shrinkage pouring temperature to solid at freezing temperature (per cent.)	0.6	4.2	5.0	5.6	5.75	7.25	7.22
Weight of metal to be fed into 100 lbs. of casting (lbs.)	0.7	4.4	5.2	6.0	6.10	7.90	7.90

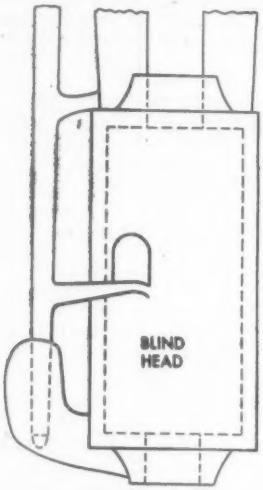
[1] Refer to section IV on Feeder Capacity. [2] 40 per cent. feeding efficiency maximum for round feeders. [3] 25 per cent. feeding efficiency with square feeders and cold metal. [4] All ferrous metals weigh 0.25 lb. per cub. in. [5] Liquid contraction per 100 deg. C., for irons 1.1 per cent., for steels 1.6 per cent.

VII. Venting Mould Cavities

The importance of venting mould cavities is realised by observing the torch effect often blowing out of a riser or vent during pouring. Indeed, whistlers is a term applied to such vents. When pouring light metals like aluminium and magnesium, special venting is necessary to prevent mould back pressure and thus to help fill the mould. All dead-end spots of a mould

Moulding Methods for Sound Castings

cavity should be vented so that the metal runs without restraint to every portion of the mould. It should also be remembered that if gas pressure is developed in a mould, there is increased tendency to force gases into the metal and cause defects (Figs. 19 and 23).



STEP-GATING

FIG. 9.—STEP GATING AND POURING THROUGH FEEDERS.

The step gates provide the first metal to remain at the bottom; the succeeding metal pours into the centre and finally into the top of the casting. The feeders in all cases receive the last metal poured. Freezing, therefore, moves toward the feeders and from the bottom to the top of the casting.

Vents are best designed to be rectangular at the casting to prevent openness and pinholes at the junction with the casting. In addition to releasing gases of the mould cavity, vents are useful in draining off the cold, and often dirty, metal frequently coming to dead-end spots of the mould. By building a pocket in the sand at the top of the vent, a small amount of metal can be drained off. This is illustrated in Fig. 23.

VIII. Porosity Caused by Hot Spots

Pressure castings often show dull, grey to black porous areas in the vicinity of gates, metal knobs or heavy bosses. This dull fracture results from the excessive heat developed by heavy gates, bosses, etc., causing rapid gas generation by the core or mould sand. This defect is distinguished from shrinkage by its dull, dark fracture, in contrast to the bright metallic fracture of pure shrinkage defects. Four approaches to this gas porosity difficulty can prevent these "leakers."

(1) If possible, use knife or fin gates (see Fig. 21).

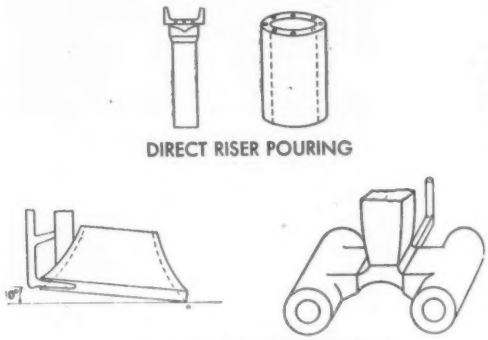
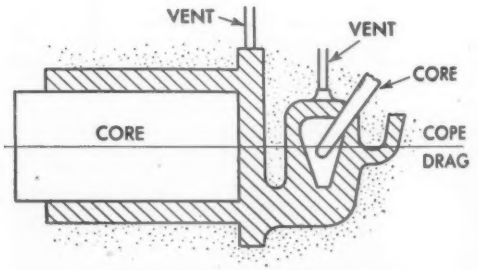


FIG. 10.—EXAMPLES OF GATING TO PROVIDE THE HOTTEST METAL IN THE BEST POSITION FOR FEEDING.



ATMOSPHERIC PRESSURE FEEDING

FIG. 11.—ILLUSTRATING THE PRINCIPLE OF THE WILLIAMS' ATMOSPHERIC PRESSURE FEEDER.

Adequate gate capacity can be obtained by using a runner with a long thin gate or many short thin ones. Such a gating system prevents hot spots in the sand or mould. The runner should have greater capacity than the total of the gates to the mould cavity, so that the runner remains full to accumulate the slag, etc., at the top with the gates taking clean metal from the bottom (see Fig. 21).

(2) Venting cores and moulds freely in the vicinity

of the "hot spots." Careful analysis of the mould around the porous area often reveals inadequate venting of the cores or of the external mould sand to release the high gas pressure developed at the metal-sand interface.

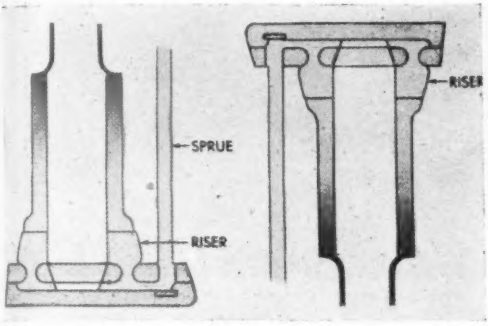


FIG. 12.—COMPLETE REVERSAL OF THE CASTING FOR FEEDING. POURED IN POSITION AT LEFT.

The mould is reversed after freezing the sprue so that the hot riser can feed the casting by gravity.

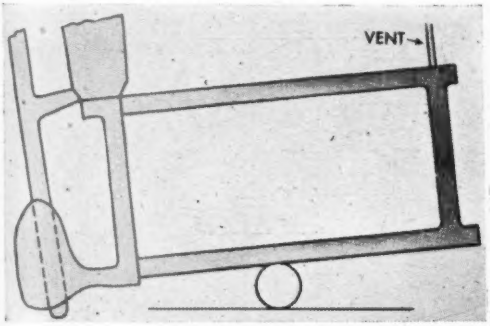


FIG. 13.—PARTIAL REVERSAL OF CASTING. POURING POSITION IS SHOWN.

Mould is tilted after pouring to provide hydrostatic pressure from feeder.

(3) It should be borne in mind that the mould and core gas pressures can become very high when molten metal touches the sand surfaces. High sand permeability and venting freely can assist in preventing these pressures from building up. However, to provide a

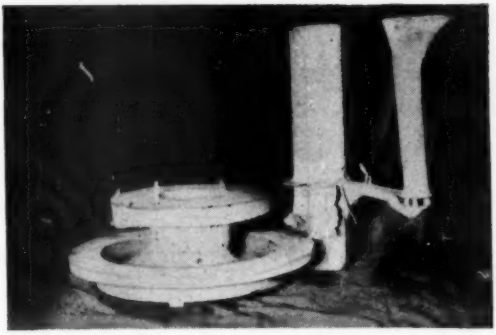
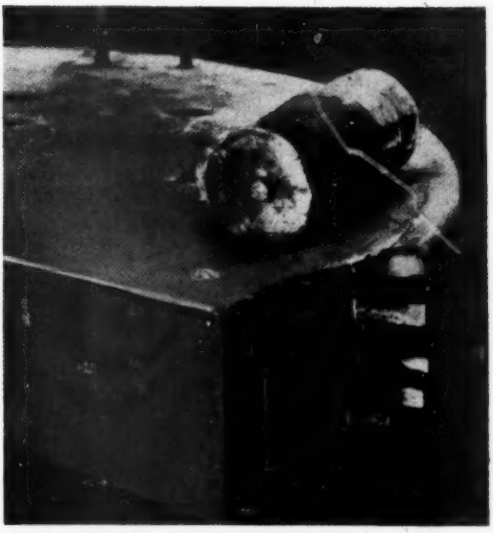


FIG. 14.—BRONZE CASTING SHOWS THE USE OF HYDROSTATIC PRESSURE FOR FEEDING.

Note coldest metal is farthest from feeder and freezing progresses toward the riser, thus assuring soundness. Note high feeder for liquid pressure.



(Courtesy Buffalo Foundry and Machinery Company.)

FIG. 15.—AN EXTREME APPLICATION OF KNOCK-OFF FEEDERS.

Feeder is 12 in. in dia., "hot topped" for a 16-in. by 14-in. by 22-in. section. Feeder connection is 2 in. dia. Density under the riser and easy removal are achieved.

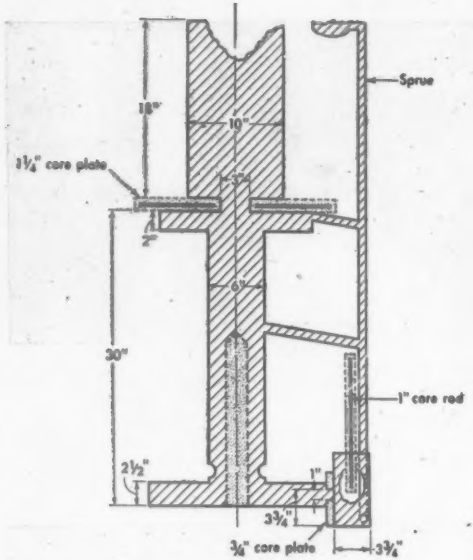


FIG. 16.—A NI-RESIST CASTING INVOLVING STEP GATES, WILLIAMS FEEDERS, GATING THROUGH THE FEEDER AND KNOCK-OFF FEEDERS.

The freezing from the thinnest sections and coldest metal to heaviest section and hottest metal in the feeders should be traced. Note relative dimensions of sections to be fed and those of feeders and feeder connections.

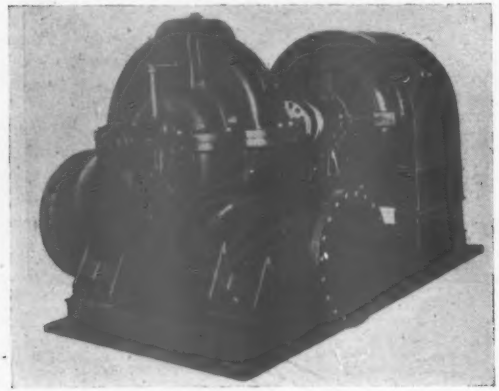
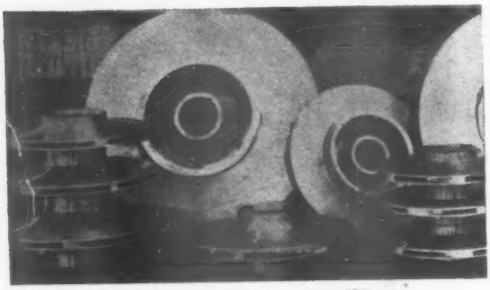


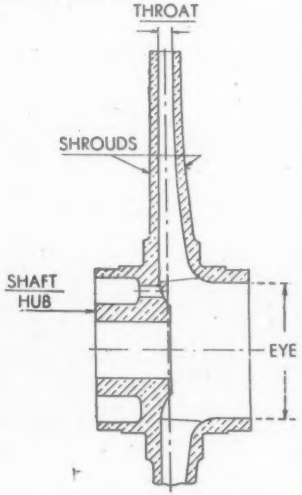
FIG. 17.—PUMP CASING SHOWING METAL JOINTS THAT WOULD MOST LIKELY REQUIRE CHILLING FOR PRESSURE TIGHTNESS.

safety factor against these gas pressures, it is recommended that the liquid pressure of the molten metal should be so high that it exceeds the maximum gas pressure at the sand face. High liquid pressure is achieved simply by high risers, mould vents and pouring basins. Figs. 14 and 23 shows the height of the



(Courtesy of Le Courtenay Company.)

FIG. 18.—PUMP IMPELLERS OF LARGE DIAMETER AND NARROW VOLUTES REQUIRE SPECIAL FOUNDRY TECHNIQUE.



CENTRIFUGAL PUMP IMPELLER
SINGLE SUCTION TYPE

(Courtesy of Le Courtenay Company.)

FIG. 19.—SECTION OF LARGE IMPELLER OF FIG. 18.

Metal poured with the axis horizontal through feeder attached to the hub, poured rapidly and freely vented with rectangular vents at the top of both shrouds.

molten metal used for these pressure castings. Note the risers along the side of the casting in Fig. 23, which were placed there primarily to provide high liquid pressure along the cylinder for some little time after pouring. The excessive cores used for this casting expanded after pouring, which more than compensated for the shrinkage of the metal. Feeding from risers, therefore, was unnecessary.

(4) The Author has also found rapid pouring of pressure castings at the proper temperature (usually quite hot) is essential. This permits easy removal of gases, dirt, etc., through the molten metal. Cold metal or slow pouring develops many areas of cold sluggish

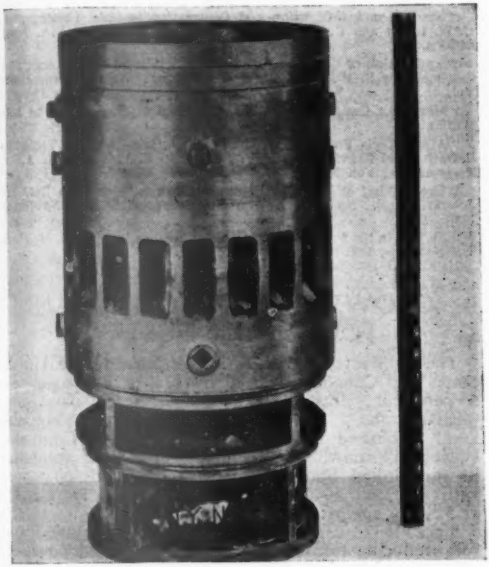


FIG. 20.—JACKETTED DIESEL ENGINE LINER MACHINED.

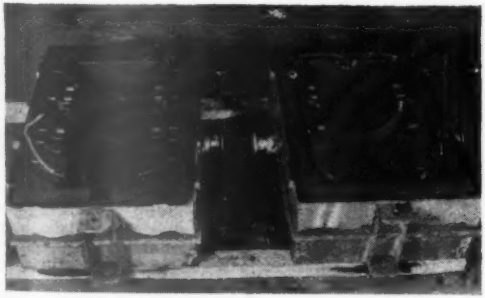


FIG. 21.—DRAG AND COPE OF GREENSAND MOULD FOR LINER OF FIG. 20. POURING SPRUE AT BACK.

Note dirt trap (dam) near sprue; knife gates in drag and slag trap (riser) at this end of runner.

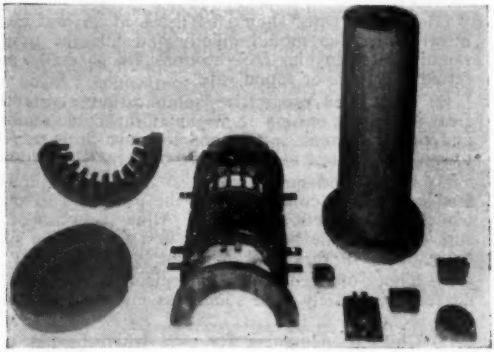


FIG. 22.—OIL-SAND CORES FOR LINER OF FIG. 20.

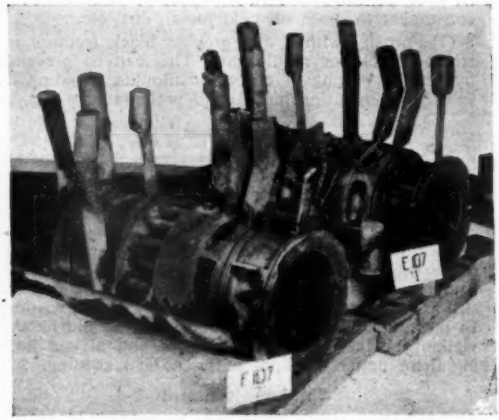


FIG. 23.—LINER OF FIG. 20 "AS CAST," SHOWING "FLOW-OFF" VENTS.

Side and flange feeders provide plenty of liquid pressure. Note feeders do very little feeding because of expansion of cores.

Moulding Methods for Sound Castings

metal which do not freely permit the removal of gases, dirt, etc.

Summary

A thorough understanding and application of only a few principles are necessary to make sound castings, no matter what metal is poured.

(1) Pouring gates should be designed so that clean metal enters the mould quietly and fills the mould rapidly. Rectangular cross-sections are generally preferred to square or round gates.

(2) Controlled progressive solidification assists the freezing of the casting to begin at the coldest metal and/or the thinnest section and to move progressively toward the hottest metal and/or the heaviest sections.

(3) Design and pour feeders so they will assuredly feed castings by conforming to the principles of controlled progressive solidification. Allow plenty of pressure to act on the molten metal in a feeder. Be sure the capacity of feeders is sufficient for the castings.

(4) Knock-off feeders are convenient to remove and do feed adequately with soundness under the feeding head or riser.

(5) Chills or denseners are used where feeders are impracticable or where it is desired to assist the freezing rate.

(6) Adequate venting the mould cavity permits filling the mould easily by preventing back pressure. Gas absorption by the metal in the mould is also reduced by good venting. Mould cavity vents or whistlers are convenient to drain off cold metal, dirt, etc.

(7) Porosity with a dull grey to black fracture is a result of core or mould gas. This can be prevented by careful venting of cores and moulds, avoiding hot spots, and by using high liquid pressure.

Conclusion

In a jobbing shop, where a wide variety of castings is made, complete records of the successful moulding practice of each casting should be kept. The best record is a photograph of the casting as poured, indicating all gates, feeders and chills, and marking all dimensions. At any future date, the casting can be made without trouble by referring to the record. The foundry industry's greatest challenge has been, and still is, the production of consistently sound castings. In meeting this challenge, foundrymen should be ever vigilant of their foundry processes and always holding them under the light of scientific reasoning.

Acknowledgment

The Author wishes to express his appreciation especially to C. W. Briggs, of the Steel Founders' Society, Cleveland, Ohio; H. F. Taylor, of the U.S. Naval Research Laboratory, Washington, D.C.; and Joseph Nixon, of the Whitehead Metal Products Company, Buffalo, New York, for the detailed instruction received on the principles for making sound castings. Further appreciation is expressed for the many suggestions received from the Author's associates of the International Nickel Company, and from the many foundrymen with whom the Author has had the opportunity to work in proving that sound castings are made by following fundamental scientific principles.

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GROWTH OF THE AMERICAN FOUNDRY INDUSTRY

The number of foundries in operation in the United States and Canada increased by 274, or approximately 5 per cent., during the past two years, data compiled for the 1945-46 edition of "Penton's Foundry List," published by the Penton Publishing Company, Cleveland, show. The number of active foundries in the United States is reported at 5,048, compared with 4,802 in 1943. The Canadian total is reported at 521, as against 493 two years ago.

Since 1943, capacity of the U.S. foundry industry for producing ferrous castings has expanded considerably more than is indicated by the gain in number of foundries. Not only have many of the newly constructed plants been large ones, but numerous older foundries have been enlarged or modernised. By actual count, total grey-iron producers declined from 2,890 in 1943 to 2,879 this year; 383 foundries are producing steel castings, compared with 335 in 1943, and the number of malleable producers has increased to 139 from 126 two years ago. Without making allowance for the fact that some ferrous foundries make more than one type of casting, this means there are 3,401 sources of ferrous castings, an increase of 50, or about 1.5 per cent., since 1943. In Canada, the increase was from 392 to 408, or 4 per cent.

Numerically, the non-ferrous group showed a much larger growth than the ferrous industry. The tabulation lists a United States total of 3,040 producers of non-ferrous castings, increase of 15.5 per cent. compared with the 2,631 two years ago.

WILL THOSE WHO sent replies to Box No. 504 on or before September 9 please be so kind as to repeat their applications, as these were inadvertently forwarded to Australia instead of being handed to the principals now visiting this country?

MOULD AND CORE PAINTS AND WASHES, AND PARTING POWDERS

By W. J. REES, O.B.E., D.Sc.Tech., F.R.I.C.
(University of Sheffield)

It has long been recognised that workers engaged in certain steel-foundry operations are exposed to the risk of silicosis, and certain of these operations, such as fettling, are included in the Various Industries (Silicosis) Scheme, 1931, made under the Workmen's Compensation Acts. In January, 1943, H.M. Chief Inspector of Factories, following on an expression of his grave concern at the marked increase in the number of certificates granted by the Silicosis Medical Board under the above Scheme to operatives in steel foundries such as dressers, fettlers, etc., appointed a committee to consider and to advise as to the best practicable means of preventing the production or the inhalation of dust in steel-foundry processes and the possibility of reducing the use of materials containing free silica. This committee reached certain conclusions, which are embodied in the First Report on Dust in Steel Foundries (H.M. Stationery Office, 1944). Among the recommendations to H.M. Chief Inspector of Factories based on these conclusions are the following:—

Core and Mould Paints.—The use of such paints containing free silica should be prohibited as soon as sufficient quantities of suitable alternative non-siliceous materials are available.

Parting Powders.—The use of parting powders containing free silica should be prohibited.

Following an approach through the Iron and Steel Institute to the Steel Castings Research Committee, consideration was given to these matters by its Moulding Materials Sub-committee. This sub-committee, following laboratory investigations, had already initiated a comprehensive series of trials in steel foundries, in which they have had the co-operation of the Foundry Practice Sub-committee.

As a result of these investigations and foundry trials, the Moulding Materials Sub-committee reported as follows:—

Core and Mould Paints.—The observations made in foundries indicate clearly that paints prepared from silica flour are a possible source of silica dust arising either during the preparation of the paint, during spraying, etc., or subsequently in the dried state during easing or fettling.

Parting Powders.—It is quite practicable, efficient, and economic to use parting powders containing no free silica. Examples of non-siliceous parting powders which have been proved to be quite satisfactory in practice are those prepared from finely ground limestone or dolomitic limestone, or precipitated calcium carbonate. These materials are usually waterproofed by thorough admixture with a small proportion of calcium or aluminium stearate, or a wax such as paraffin wax. Other satisfactory non-siliceous materials have been prepared from calcined aluminous fireclay and sillimanite.

* A Paper prepared for presentation to the Iron and Steel Institute on behalf of the Moulding Materials Sub-committee of the Steel Castings Research Committee.

Initial Experiments

The initial series of experiments indicated that from the technical viewpoint it would be practicable and efficient to use paints prepared from such non-siliceous materials as sillimanite, calcined or fused alumina, or china clay calcined to vitrification. A comprehensive series of trials with these and other materials has been carried through in a number of steel foundries under ordinary conditions of foundry practice.

The technique of preparing the paint needs no modification when the non-siliceous materials are used in place of silica flour, using the same suspensory agents, but small modifications in the density of the paint may be desirable to suit individual foundry practices. The particle size of the silica flour used has been found to vary over a wide range, the specific surface of this material in use in foundries for paint production varying between 1,500 and 10,000 sq. cm./g. The paint prepared from the finer materials spreads well and gives a thin adherent coat, but some foundries prefer the thicker coat given by the coarser material, especially on the larger sizes of cores and moulds, even though the skin may be less smooth. The same range of particle size has been found to be applicable with the alternative materials.

A fundamental difference between silica and the non-siliceous materials used in the trials is that the former expands at high temperature (*i.e.*, above 1,470 deg. C.) because of the trend for the quartz with a sp. gr. of 2.65 to invert to cristobalite or tridymite with a sp. gr. of 2.28-2.33, whilst the latter show either no permanent volume change or a small shrinkage. It has been shown, however, that silica paint mixtures undergo a small shrinkage at high temperature, owing to drying and sintering, when test-pieces prepared from the paint mixture with 7 per cent. of water are dried and fired at 1,600 deg. C. T. R. Walker, in a series of tests, found that fused alumina and zircon paint mixtures show about the same shrinkage as silica in this test, but calcined china clay shrinks much more. Further laboratory work and foundry trials are necessary before the effect of this characteristic, which will be affected by the particle size of the material, can be evaluated. It may be of more importance with large than with small castings, as one non-siliceous material which shows a much higher shrinkage than silica in the above test is giving completely satisfactory results with small and medium-size castings.

The suspensory agents usually used in the paints include bentonite, Fulbond No. 2, ball clay, core creams, dextrin, starch, sulphite lye, etc., but experimental work with other agents, such as artificial resins, is in progress.

Typical Paint Mixture

A typical paint mixture which has been used in many of the foundry trials is:—Sillimanite or other paint base, 100 lb.; bentonite, 2½ lb.; core cream, 5 lb.; sulphite lye, 2½ lb., and water, 8 gall. In making this paint the bentonite was first stirred into about half the total volume of water and the paint base then added gradually with thorough stirring; the core cream and sulphite lye were then each stirred separately into 1 gall. of water and these were added to the paint-

base/bentonite mix, the remainder of the water was added and the whole thoroughly stirred to a smooth emulsion. Fulbond may be used satisfactorily in place of bentonite, the weight used being increased to 3½ lb.

Paints have also been made using ball clay and dextrin in place of the bentonite, core cream and sulphite lye, a typical mixture being:—Paint base, 100 lb.; ball clay, 15 lb.; dextrin, 2½ lb., and water, 8 gall.

The non-siliceous materials which have been used in foundry trials include molochite (vitrified china clay), calcined aluminous fireclay (chamotte), sillimanite, calcined alumina, fused alumina or alundum, and zircon; all these were used in the "flour" condition, the specific surface being in the range of 2,000 to 6,000 sq. cm./g. The general conclusion from these trials is that it is quite practicable to eliminate silica flour from steel foundry mould and core paints.

Experimental Results

The following is a general review of the foundry trials with the different non-siliceous materials.

Molochite.—This material is giving results at least equal to those obtained with silica paints on light- and medium-weight castings. On large and thick-walled castings the results reported are variable, but in general it is to be concluded that the results are not quite equal to those obtained with silica paint under the same conditions.

Calcined Aluminous Clay (*Chamotte*) is yielding results equal to those obtained with silica paint on medium-weight castings. One foundry reports that this material is now in regular and successful use on castings with a section up to 4 in., and that it has been found particularly satisfactory with manganese steel.

Sillimanite is giving satisfactory results in a number of foundries, but on heavy and thick-sectioned castings the results reported are erratic. One large foundry producing 500-lb. M.C. bombs has reported that "this material has now been in general use in the foundry for the past year, and results much better than those with silica flour are being obtained. The paint as used has a sp. gr. of 1.58." In this foundry the paint is prepared as follows: 3 cwt. of the sillimanite flour and 17 lb. of bentonite are intimately mixed dry; this mixture is added to 20 gall. of water and 27 quarts of paint cream (25 parts by weight of baltiseed cream mixed with 14 parts by weight of sulphite lye) and stirred into a creamy consistency. This mixture is then diluted to the desired specific gravity, which is adjusted to give ease of application with brushes and minimum settlement in the mixing tanks.

Fused Alumina

From most of the trials with this fused alumina good results have been reported, but in one or two cases results below standard in stripping have been obtained. One foundry has reported a trial with pulverised scrap alundum grinding wheels: "After burning out the bond and pulverising, this material makes very successful paint, bonded either with oil or clay, and several good results have been obtained, notably on a coupling box of 6-in. section."

Zircon (*Zirconium Silicate*).—The foundry trials with this material are uniformly satisfactory; particularly good results have been obtained on dry-sand work, especially for cores surrounded by heavy metal sections. Information has been received that this material is giving highly satisfactory results in some American steel foundries. The fusion points, by cone test, of the materials used in the trials are: Molochite, 1,710 deg. C.; calcined aluminous clay, 1,720 deg. C.; sillimanite, 1,850 deg. C.; fused alumina, 1,960 deg. C., and zircon, 2,100 deg. C. That of typical silica flour is 1,710 to 1,720 deg. C.

Trials have been made in several foundries with proprietary non-siliceous paints, with variable results. Steel-foundry trials with paints based on serpentine and mica have given unsatisfactory results, burning-on and bad stripping being reported; but it is likely that these materials would be suitable for iron and non-ferrous foundry use.

The conclusion from the foundry trials as a whole is that, from the technical viewpoint, one or other of the non-siliceous alternatives to silica will give quite satisfactory results in steel-foundry mould and core paints. Most of these materials are more costly than average silica flour, but there are definite indications from some of the trials that the increased cost is offset by improved results, particularly reductions in fettling costs.

STEEL CASTINGS BY THE THERMIT PROCESS

Development of a special type of thermit, known as Thermicast, for producing steel castings, has been announced by the Metal & Thermit Corporation, of New York. The new type of thermit is said to solve the problem of obtaining sound, clean steel castings quickly and simply, irrespective of size and intricacy of shape, when regular steel melting facilities are unavailable. Thermicast is especially designed for the production of steel castings and is not to be associated with conventional thermit welding, for which it is not suitable.

The new casting material utilises the well-known thermit reaction, which is carried out in a specially designed conical-shaped crucible of sheet steel lined with refractory material. Most of the equipment required to produce the castings can be improvised, and little experience to produce steel castings by the process is necessary.

Thermicast is available in 41-lb. bags, each of which produces approximately 25 lb. of steel. The Thermicast steel, as cast, has the following average mechanical properties:—Yield point, 17.5 tons per sq. in.; tensile strength, 31.3 tons per sq. in.; elongation in 2 in., 30.1 per cent., and reduction in area, 51.2 per cent.

JARROW-ON-TYNE CORPORATION INDUSTRIES COMMITTEE has appointed a deputation to interview the Board of Trade regarding the setting up of a trading estate in the Jarrow area. At a meeting of the Committee, the Mayor (Ald. G. A. Rose) referred to the impending closing down of a local factory employing 1,400 people as a result of the stopping of war contracts.

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PERSONAL

MR. A. M. BAER has been elected a director of Henry Gardner & Company, Limited.

MR. W. O. J. URRY has been elected a director of Heenan & Froude, Limited, engineers and ironfounders, of Worcester.

MR. ERIC W. MUIRSMITH has for reasons of health resigned from the board of the Scottish Machine Tool Corporation, Limited.

MR. H. D. M. WRIGHT and MR. L. R. HONEYWILL have accepted invitations to join the board of the Butterley Company, Limited.

MR. DAVID HILL, who for many years has been a director and the secretary of John Thompson Engineering Company, Limited, and associated concerns, Ettingshall Works, Wolverhampton, has just retired after 52 years' service.

MR. HOWARD MARSHALL has been appointed to a new but unnamed post created by Richard Thomas & Baldwins, Limited, and will devote his whole time to problems of welfare, recruitment, education, and health of the employees.

MR. J. W. ONIONS has been appointed managing director of Ibbotson Bros. & Company, Limited, Sheffield. MR. J. W. RAMSDEN, recently general manager of Ibbotson Bros., has been appointed managing director of Willford & Company.

MR. P. A. J. LINFORTH has resigned his position as personnel manager with British Timken, Limited, and has now joined Silentbloc, Limited, in connection with the technical and commercial development of that company's products in the Midlands.

MR. W. C. V. APPS, for 14 years manager of Cookley Ironworks, Brierley Hill (Richard Thomas & Baldwins, Limited), recently received a presentation from the staff and workpeople. He is leaving to take up an appointment on the board of directors of John Fowler & Company (Leeds), Limited.

MR. AND MRS. HAROLD WRIGHT, of Linthorpe, Middlesbrough, celebrated their golden wedding on September 4. Mr. Wright, who is chief metallurgist to Dorman, Long & Company, Limited, was recently awarded the Bessemer Gold Medal by the Iron and Steel Institute. Mrs. Wright was awarded the O.B.E. for her public services during the war.

MR. E. H. LEVER and LT.-COL. JOHN BEAUMONT NEILSON have been appointed joint managing directors of Richard Thomas & Baldwins, Limited. At the unanimous request of the directors at a board meeting held on August 27, the first since the termination of control, Mr. Lever agreed to continue in office as chairman of the company and MR. J. E. JAMES as deputy chairman.

MR. SAMUEL ERIC OSBORN, managing director of Samuel Osborn & Company, Limited, steel manufacturers, has been elected Master Cutler of Sheffield. His father, his maternal grandfather and his paternal grandfather all held this ancient office, which dates back to 1624. Mr. Osborn succeeds Mr. W. W. Wood, who has held the office for five successive years and was also Master Cutler in 1924.

MR. RALPH ALSOP has resigned the position of managing director of the Consett Iron Company, Limited. His health, the company states, has been seriously affected by the great strain and work resulting directly from the war effort. He will, however, retain his seat on the board. Mr. Alsop entered the service of the company at its head office in Consett in 1903. The executive management of the company will be undertaken by MR. HAROLD BOOT, director and general manager.

MR. WALTON WILLIAMS, works manager of the Clayton Tinplate Company's works at Pontardulais (a subsidiary of Richard Thomas & Baldwins, Limited), has been appointed personnel manager of the new watch factory now in course of erection at Ystradgynlais, Swansea Valley, for S. Smith & Sons (England), Limited. Mr. Williams was previously works manager of the Glanrhyd Tinplate Works in the Gilbertson group of Richard Thomas & Baldwins, Limited. He first joined Richard Thomas in 1923 in their Grovesend works.

MR. A. L. SCOTSON, chief engineer to Dorman, Long & Company, Limited, at their ironstone mines and limestone quarries, retired at the end of August after 37 years' service with the company. He is succeeded by MR. V. H. PRYKE, chief draughtsman at the ironstone mines. Mr. Scotson was educated at King Edward's School, Birmingham, and served his apprenticeship in the engineering shops of the bridge and constructional department of the Patent Shaft & Axletree Company, Limited, Wednesbury. He went north in 1902 to join the staff of the Cargo Fleet Iron Company, Limited. In 1908 Mr. Scotson became assistant to the chief engineer at Bolckow, Vaughan & Company's Cleveland Works, and was appointed chief mechanical engineer of the ironstone mines of that company in 1915. When the amalgamation with Dorman, Long & Company, Limited, took place in 1929, Mr. Scotson also took over the additional duties of engineer at that company's ironstone mines and limestone quarries and at their ironstone quarry in Rutland. To mark his long association with the ironstone mines and quarries, Mr. Scotson received on August 29 a presentation subscribed for by the managerial, technical and clerical staffs.

STEEL PIPES FOR IRAQ

The late Sir Allan Macdiarmid, in his speech at the annual meeting of Stewarts and Lloyds, Limited, on May 17, referred to the heavy demands likely to be made by the oil industry for tubular goods. It can now be stated that in addition to the abnormal requirements already placed by British-owned oil companies, Stewarts and Lloyds have been entrusted with the contract to supply the pipe-line for the Iraq Petroleum Company, Limited. The Iraq pipe-line is to be duplicated, and the present contract, totalling 120,000 tons of 16-in. dia. pipe, is the largest order for steel pipes ever placed in this country.

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The small Wheelabrator Tum Blast (WTBO) illustrated above is especially suitable for small production requirements and is very successful in the cleaning of very fragile pieces and hardened parts. The total h.p. required, including exhaust fan and Dust Arrester is 9½. The Tum Blast range is completed by three larger sizes.

Sole Makers and Suppliers in British Empire (excluding Canada) :

TILGHMAN'S PATENT SAND BLAST CO. LTD.

BROADHEATH, Nr. MANCHESTER

G.35

NEWS IN BRIEF

WILLIAM BEARDMORE & COMPANY, LIMITED, have put in hand schemes of modernisation at Parkhead Forge which will cost about £1,000,000.

THOMPSON BROS. (BILSTON), LIMITED, have posted letters of right for an issue of 119,472 5s. ordinary shares at 15s. each in the proportion of one for every three held.

MORE THAN 1,000 EMPLOYEES at the Bedewell Engineering Works, Hebburn-on-Tyne, have been given notice terminating their employment. The factory, which was established by Sir John Jarvis, was opened shortly after the war started and has been making bombs.

COLVILLES, LIMITED, are shortly to undertake the construction of a new melting shop at their Dalzell works at a cost of about £2 million. Other improvements, involving about £1,000,000, are to be carried out at their Clyde, Glengarnock, Clydebridge and Blochairn works.

THE BETHLEHEM STEEL COMPANY'S post-war employment figure is estimated at 160,000, or 60 per cent. greater than the 1937 pre-war peak of 100,000 workers, according to Mr. E. G. Grace, the president. The peak war employment for the company was in the last quarter of 1943, when there were nearly 300,000 on the payroll.

UNRRA SHIPMENTS TO Eastern Europe and Mediterranean countries up to the end of July totalled 1,334,950 gross tons, of a landed cost of about £80,000,000, it is reported. This excludes supplies taken over from the military for Unrra camps; contributed clothing from the Western Hemisphere and coal and liquid fuel to Greece, Yugoslavia and Albania, which were the responsibility of the military during July, although the cost will eventually be borne by Unrra.

THE GENERAL ELECTRIC COMPANY, LIMITED, has entered into an arrangement with Mort's Dock & Engineering, of Sydney, N.S.W., under which Mort's Dock will manufacture for the G.E.C. certain parts of mechanical plant which can be economically produced in Australia, the other parts being supplied by the G.E.C. home factories. The G.E.C. has an option exercisable at a future date to acquire up to 10 per cent. of the issued capital of Mort's Dock, which is at present £650,000.

THE REPORT for 1944 of International Aluminium, Limited, states that activities were drastically restricted owing to circumstances beyond the company's control. The alumina works at Hebburn-on-Tyne had to be closed on May 15, 1944, and cannot now be economically restarted. The company consequently ceased trading at the end of 1944. Its main asset, now as previously, is its interest in its Norwegian subsidiary, A/S Haugvik Smelterverk, in which it owns all the shares. Information received is that the latter's works are intact, but it has not yet been possible to make any arrangements as to future operation.

A FUSION OF INTERESTS between three companies engaged in hydraulic engineering is indicated by the announcement that Glenfield & Kennedy, Limited, Kilmarnock, have reached provisional agreements with Alley & Maclellan, Limited, Glasgow, and J. Blakeborough & Sons, Limited, Brighouse, Yorks. In a circular to shareholders the directors of Glenfield & Kennedy state that offers to the ordinary shareholders of the other two companies will be made to exchange their holdings for fully-paid ordinary shares in Glenfield & Kennedy. The company already holds part of the J. Blakeborough ordinary capital.

BELGIAN STEEL INDUSTRY

With increased arrivals of coke and the prospect of supplies of Swedish ore, it seems likely that the basic programme of the Belgian iron and steel industry will be fulfilled. At present, 13 blast furnaces are in operation in Belgium and five in Luxemburg—two at Dudelange and three at Differdange. These are not sufficient for the projected programme of 120,000 tons of steel, but no furnaces have yet been blown in at the Sambre-et-Moselle, Esperance-Longdoz, and Boël, and other plants, notably Clabecq and the A.M.S., are working under uneconomic conditions with a reduced number of furnaces in operation. Conversations are being held regarding the increase of iron and steel prices, but no decisions have yet been taken.

The Belgian scrap market is still under depressing influences, dealers refusing to sell at prices they consider too low in regard to the heavy costs of labour and maintenance. The tendency of the market, however, remains weak owing to the abundance of ordinary scrap. Offers of special scrap are less numerous. It is now considered possible that American military equipment will not be shipped back to the United States, as originally intended, and will thus form a source of scrap for some time to come.

BRITISH METAL CORPORATION

The British Metal Corporation, Limited, announce that as their agreement for operating the Ministry of Supply Non-Ferrous Metals Control terminated on August 31, they have resumed their trade activities at their pre-war address, Princes House, Gresham Street, London, E.C.2. All future communications should be sent to the Corporation at that address. The business of the Corporation's subsidiary, the Continental Metal & Minerals Company, Limited, which has transacted foreign business during the war years, has been taken over by the Corporation, and will be carried on only for the completion of existing contracts.

A MECHANISED FOUNDRY incorporating the most modern plant and methods is an outstanding feature of the agricultural factory established by Stewarts and Lloyds of South Africa, Limited, at their Vereeniging Works, where Glenfield & Kennedy valves, Worthington pumps and Climax windmills are manufactured under licence, all these products being made in Meehanite.

Design by Eric Fraser

MOSAICS OF STEEL

NUMBER SEVEN

At the United Strip and Bar Mills Templeboro plant are installed the pioneer rolling mills in this country, for the continuous large scale production of hot-rolled steel strip. From billets produced in the adjacent melting shops and rolling mills. the steel strip is produced at incredible speed. Much of the strip produced is destined for further processing by cold rolling, but large tonnages are used in all engineering trades for parts which can be rolled, pressed or otherwise formed, and in the manufacture of tubes.

THE UNITED STEEL COMPANIES LTD

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STEEL, PEECH & TOZER, SHEFFIELD
SAMUEL FOX & CO. LTD., SHEFFIELD
UNITED STRIP & BAR MILLS, SHEFFIELD

APPLEBY-FRODINGHAM STEEL CO. LTD., SCUNTHORPE
WORKINGTON IRON & STEEL CO., WORKINGTON
UNITED COKE & CHEMICALS CO. LTD., CUMBERLAND

THE ROTHERVALE COLLIERIES, TREETON
THE SHEFFIELD COAL CO. LTD., TREETON
THOS. BUTLIN & CO., WELLINGBOROUGH

USP.51

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Slag Aggregates—£25,000. G. Conrad, 103, Phyllis Avenue, New Malden, subscriber.

Aldic Engineering Company—£100,000. J. Madders, 53, Hedge Lane, London, N.13, subscriber.

Carley Tipping Gear Company, 36, Clegg Street, Oldham—£5,000. H. Hilton and H. Gartside.

Gilbow Tool & Steel Company, Bridge Street, Sheffield—£10,000. J. W., M. E. and G. O. Ward.

Metal Industries (Electrical Group)—£1,000. W. B. Hardie, 113, St. Vincent Street, Glasgow, subscriber.

James Archer, South Ward Road, Dundee—Engineers. £1,000. J. Archer, J. Archer, jun., and G. W. Archer.

Pama Engineering Company—£1,000. A. Fletcher, Ellerwood, Bowness-on-Windermere, Westmorland, subscriber.

J. B. Garnham & Sons, 100, Brighton Road, Surrey—Merchants and brokers of metals. £50,000. F. M. and G. B. Garnham.

Walker & Wilkinson—Engineers, etc. £1,000. W. and J. Wilkinson, 39, Hill Crest, Burnley Road, Sowerby Bridge.

Bayham—Mechanical and electrical engineers, etc. £50,000. C. H. Brooks, 27, Fineleigh Court, Bath Road, Slough, subscriber.

B. G. Plant (Sales Agency), The Gables, Appleton, Abingdon, Berks.—Machinery and metal merchants, etc. £1,000. B. H. and O. Gaster.

New Engineering (Coventry), Garden Road, 24, Smithford Street, Coventry—£2,000. J. M. Meston, L. H. Newman, C. Woodend and F. White.

Qualcraft General Engineering Products, Estate Office, Mountain Road, Caerphilly, Glam.—£2,000. E. E. Churchouse, W. E. Price and E. B. Williams.

NEW TRADE MARKS

The following applications to register trade marks appear in the "Trade Marks Journal":—

"AEROLEX"—Machine tools. AEROLEX, LIMITED, Bridge Road, Camberley, Surrey.

"MILOVIS"—Milling machines, machine tools, etc. HOVIS, LIMITED, 154, Grosvenor Road, Westminster, London, S.W.1.

"MAGNABONDO"—Moulding powder for use in foundries. WILLIAM CUMMING & COMPANY, LIMITED, Kelvindale Mills, Maryhill, Glasgow, N.W.

RECENT WILLS

CLEMENTS, S. D., chairman of Derbyshire Stone, Limited	£184,164
ROBERTS, E., of Bolton, mechanical engineer, director of Mather & Platt, Limited, Manchester	£51,458
EASTWOOD, H. A., of Fleet, a director of the Farnley Iron Company (Fireclay Works), Limited, Leeds	£74,524

NEW PATENTS

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

570,310 STEVENS, R. J., and BURNHAM, T. H. Production of thin metallic films or coatings.

570,325 PROCTOR, W. F., and WEBB, G. W. Casting of metals.

570,355 LUMSDEN MACHINE COMPANY, LIMITED, BLAKE, E. G., LUMSDEN, W., STANIER, J. H., and BLAKE, A. H. Magnetic devices for removing ferrous particles from water.

570,372 WELLMAN SMITH OWEN ENGINEERING CORPORATION, LIMITED, and NEWMAN, F. S. Slab and like handling machines.

570,373 BRIGGS MANUFACTURING COMPANY. Treatment of tubing.

570,423 MOND NICKEL COMPANY, LIMITED. Casting of metals.

570,486 GUEST, KEEN & NETTLEFOLDS, LIMITED, and OAKLEY, M. C. Bolts.

570,503 CONSTRUCTORS, LIMITED, and FINER, H. J. Perforated metal bar members of angle section.

570,514 SPEAR & JACKSON, LIMITED, and PARSONS, G. W. Tipping of saw teeth with hard metals.

570,516 PRIEST, C. F. Gas-fired reheating furnaces.

570,535 BRITISH THOMSON-HOUSTON COMPANY, LIMITED (General Electric Company). Methods of drying plastic materials formed of powdered metal and a plasticising medium.

TIN UNDERCOATS ON PAINTED STEEL

The effectiveness of tin undercoats on painted steel in retarding corrosion has been examined by Ernest S. Hedges, D.Sc., Ph.D., and L. A. Jordan, D.Sc., and the results embodied in a Paper entitled "The Use of a Tin Undercoat to Improve the Corrosion Resistance of Painted Steel," submitted to the Iron and Steel Institute. The investigations covered electrodeposits of tin from both the alkaline and acid tin baths, using thicknesses of 0.000008 and 0.00003 in., and the effect of flash-melting the tin coatings and of oxidising the tin surface by chemical treatments; in addition, specimens of plain steel, hot-dipped tinplate and phosphated steel were included in the series. Twelve different paints were applied, including linseed-oil paints, nitrocellulose-lacquer, stoving paints, and air-drying japans. Accelerated corrosion tests show that treatment with electrodeposited tin, especially when followed by the application of the T.R.I. (Tin Research Institute) anti-rusting oxide film, adds very greatly to the protection afforded by the paints. The best treatment was 0.00003 in. of tin electrodeposited from the sodium stannate bath and further protected by the T.R.I. film.

A MEETING OF THE Birmingham branch of the Institute of Welding will be held at the James Watt Memorial Institute, Great Charles Street, Birmingham, tomorrow (Friday) at 6.30 p.m.

THE PREMATURE END OF MANY REFRACTORIES

—written in Fireclay Joints

2

JOINTS are the weakest part of a furnace lining. Ordinary fireclay as a jointing material has certain fundamental disadvantages—it shrinks on drying and again on firing—the bricks do not remain bonded—and fireclay joints are readily attacked by slag. Durax No. 3 Refractory Cement for use with all types of fireclay bricks is a jointing material specially developed to overcome these serious disadvantages. It ensures the thinnest possible joints—sets hard without heat—and does not shrink during drying or firing.

Joints made with Durax No. 3 are as strong and as slag resistant as the fireclay bricks themselves. Its use ensures sound and homogeneous structures from which users can expect long life with a minimum of repairs. Full details on request.

DURAX No. 3 REFRACTORY CEMENT

NO SHRINKAGE. *Illustration (1) shows one firebrick coated with fireclay and the other with Durax No. 3. Both were allowed to dry at atmospheric temperature. The results are easily comparable in the photographic reproductions.*

STRENGTH. *Illustration (2) shows two test pieces allowed to dry at atmospheric temperature, and one fired to 1500°C. Tensile strength results — Unfired: 115 lbs. per sq. in. Fired: 912 lbs. per sq. in.*

FIRECBRICKS. BASIC BRICKS
ACID-PROOF MATERIALS
CEMENTS. PLASTICS
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TELEPHONE 31113 (6 LINES) 34.

Raw Material Markets

IRON AND STEEL

Replacement of old blast furnaces by new ones of bigger capacity and greater efficiency figures prominently in the iron and steel industry's five-year plan. Meanwhile, there is a sufficient number of furnaces to provide all the pig-iron required, subject only to the availability of adequate supplies of coke. That, however, is entirely dependent upon the response made by the miners to the urgent appeals of the Ministry of Fuel and Power and their own leaders for increased outputs. At the moment, an approximate balance between production and consumption is maintained.

There seems to be a sufficiency of low-phosphorus and hematite grades, but applications for licensed tonnages of foundry iron indicate that bigger quantities than are at present available are required for the light-castings trade, which obviously has a long period of activity in front of it. In the foundry trade, as in so many other branches of industry at the present time, labour shortage is the chief influence.

Supplies of foundry coke are coming forward fairly well and some users have been able to put down a little stock, which no doubt will serve them in good stead in the winter months. The scrap situation, although not exactly easy, is better than it was and supplies generally are coming forward satisfactorily.

Re-rollers of steel have in hand a fair volume of orders for light sections, small bars, etc., and are finding it difficult to acquire prime billets in adequate quantities. This is largely due to the pressure for sheet bars. All the sheet mills are working to capacity and at present the onus of providing the whole of the bars required falls upon home producers, whose resources are severely strained to keep pace with the demand.

There have been relatively few cancellations of orders for heavy finished steel and the volume of export business is steadily rising. The plate and section mills, in fact, have attained a state of full employment and there are many further inquiries which seem likely to mature. Shipbuilders' specifications are on a heavier scale, and the plate mills also receive steady support from the builders of rolling stock and the boiler makers. The rail mills will be turning out maximum tonnages to the end of the year, and possibly throughout 1946, in order to meet the needs of the British railways and to restore the ravages of European transport.

NON-FERROUS METALS

The tin supply position has not altered greatly in the last few weeks. Sufficient metal appears to be forthcoming to meet this country's essential needs, but the position in America does not seem to be entirely happy. It may be a considerable time yet before supplies from Malaya and the Dutch East Indies are available to us and to our American friends. In the meantime, economy in the use of the metal will be imperative and the employment of substitutes must be continued. Supplies of most of the other metals are forthcoming in good quantity and, generally speaking, a fairly easy situation exists. The Non-Ferrous Metals Control of the Ministry of Supply has given way to the Directorate of Non-Ferrous Metals. Such control as remains is now loosely applied so far as copper, lead, zinc and aluminium are concerned, and the trade looks forward to the day when control will be lifted entirely.

NEW CATALOGUES

Rubber Bonded to Metal. Rubber Bonders, Limited, Flexilant Works, Dunstable, Beds, have sent us a copy of "Flexible Commentary." This publication, for which a charge of 15s. is made, takes the form of a loose-leaf binder of foolscap size, divided into sections by tabbing. It is an unusual and rather striking presentation of bold design, yet quite pleasing. It will appeal most to the designer, for the marriage between rubber and metal is still a long way from reaching the "silver wedding" stage. The applications are seemingly endless. Some, such as flexible couplings and mountings, are obvious. Others, such as for machine mountings, are attractive but may require discretion in application where a jar action has to be retained. Then there are the cases of rubber-lined vessels, pumps and pipes for curing corrosion troubles, whilst in the field of erosion prevention, the system is suggested for lining ball mills, dredger buckets and shot blast tubes. Then there remains the wide spheres of application for jointing and scaling. Two of the tabs read "to set you thinking" and if this is the main object of the brochure it has well fulfilled its purpose.

Two-metre Spectrograph. The Applied Research Laboratories, 4336, San Fernando Road, Glendale, 4, California, and the Harry W. Dietert Company, 9330, Roselawn, Detroit, 4, Michigan, now have ready for distribution a four-page folder describing the new two-meter grating spectrograph. This new instrument is designed with 36,600 lines per in. or 91,500 total grating lines, representing an unusually fine ruling. This has made possible the production of a high dispersion unit without resorting to a bulky, long focal length. A 24-in. camera provides a 20-in. spectrogram on 35-mm. spectrum film. The camera is movable on a radius arm which means that the operator can effect positioning along the Rowland circle so that any 20-in. portion of the total 60-in. spectrum may be photographed at one time.

Combustion Furnace. The Harry W. Dietert Company, of 9330, Roselawn Avenue, Detroit, 4, Mich., U.S.A., has sent us an illustrated leaflet describing the Glotemp combustion furnace. It is a two-tube, 2-k.v.a. furnace of exceptionally neat design. The actual furnace is but 10 ins. long and is built over and integral with the electrical controls. The leaflet is available to our readers on writing to Detroit.